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Interactive comment on "Linking the distribution of microbial deposits from the Great Salt Lake (Utah, USA) to tectonic and climatic processes" *by* A. Bouton et al.

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We thank the anonymous Referee #3 for her/his appreciation of the manuscript and constructive comments. Replies to the raised points are provided below:

General comments: Referee #3 raised the complex relationships between microbialites and geological/geographical structures such as the shorelines. For instance, the presence of cow pie structures is related to a very low water elevation. The observation of present-day microbial structures in the GSL indicates that cow pies are preferentially restricted to the shoreline area and, occasionally, in local topographic highs disconnected from the shoreline (see Bouton et al., 2016, Sedimentary Geology). Therefore, the type of microbial structures and their distribution can be powerful tools to track the

position of the shoreline through time, and thus, of the water lake level.

Some alignments of microbial deposits were interpreted in this manuscript as paleoshorelines. As mentioned by Referee #3, some of these alignments may coincide with faults, depending where observations are made. In NW Antelope Island (Fig. 5C), the alignments strongly follow the crooked geometry of the coast; while they are partly conform with a N135° fault orientation at the western margin (Dinter and Pechmann, 2014). These alignments can be followed northward all along the coast where they differ from the general fault pattern. Both systems (paleoshorelines and fault-dominated alignments) may coincide, but their own characteristics (e.g. topographic drop-off vs. the coastal morphology) allow to discriminate them.

As mentioned, fluid circulation through faults or cracks associated with polygonal networks may provide an important source of Ca^{2+} in the lake, favouring the carbonate precipitation and therefore, the formation of microbialites. However, we also notice that the presence of microbialites in the centre of polygonal structures cannot be explained by fluid transfers from the polygon edges. As a result if faults or cracks may indeed help microbialites formation, the latter is not restricted to this peculiar way of circulating the fluid.

This statement is further supported by the observation that while the Ca^{2+} content is low in the GSL water (ca. 230 mg/l; USGS data), it does not prevent the precipitation of carbonate phase within microbial mats at equilibrium with surface water according to the saturation index of aragonite and dolomite calculated using Phreeqc modelling (see attached figure). GSL waters are supersaturated respectively to these mineral phases allowing precipitation of carbonates everywhere in the lake and not only in relation with fault circulating fluids.

Deep microbial structures have been recognized in the literature (Colman et al., 2002) and acknowledge in this work (Fig. 5C- dashed yellow polygons). However, they are rarer than shallow microbialites. We agree that the clarity of the water may have somewhat altered our mapping of deep structures. Nevertheless, the large studied dataset of aerial and satellite images (continuous since 1972 and throughout different season of the year) repeatedly indicate that deep structures are scarce and patchy.

Specific and technical comments:

We thank the Referee #3 for his/her specific and technical comments. These modifications will be introduced in the next version of the paper.

- Page 1, lines 19-20: the term “system” appeared twice in the same sentence, the first was changed into “lake”.

- Page 1, line 29: the term “macrofabric” was put in singular.

- Page 4, lines 8-9: the abbreviation AMS (Accelerator Mass Spectrometry) was defined and the text was changed in consequence.

- Page 4, lines 17-20: we agree that “microbially-mediated precipitation” and “trapping and binding” are different, but they both contribute to the formation of microbialites as they are intrinsically linked. In addition, the historical definition of microbialites by Burne and Moore, (1987) including their formation refers to both processes. A reference to Burne and Moore (1987) was added in the text in that sense.

- Page 4, lines 20-21: we think that it is not relevant to specify here the type of microbialites, which host living microbial mats since these microbial structures are not yet described in the main text. These microbial structures are described just below including information if they host living microbial mats. However, in page 8, line 3, we agree that this information can be helpful to precise the relation between living microbial mats and the different microbialites.

- Page 5, line 1: we changed “just few” by “slightly above” in order to clarify the text.

- Page 5, line 2: we agree with this comment and we modified the text accordingly (plural to “thicknesses”).

- Page 5, line 18: we added “the” before boulders.

- Page 8, line 29: We agree with Referee #3’s comment and we added the suggested sentence in the text.

- Figure 3: The description of a panel E in the caption is a remnant of a previous version of the manuscript. This will be deleted.

On the behalf of my co-authors, kindest regards.

Anthony Bouton

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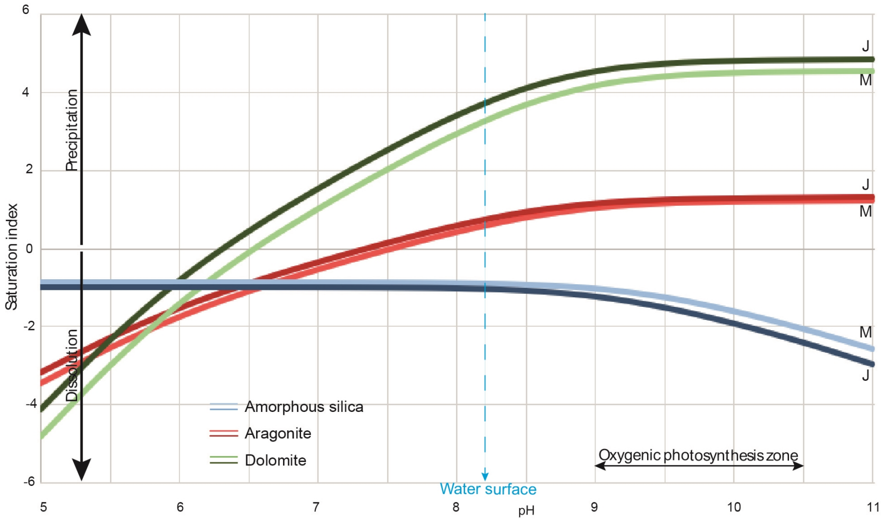

Figure S8: Results of Phreeqc modelling based on GSL surface water composition (USGS; Table S2). Saturation index as a function of the pH for three minerals (amorphous silica, aragonite and dolomite). Each mineral is represented by two curves showing the variation induced by seasonal temperature fluctuations (M: May; J: July).

Fig. 1.